WHAT IS CLAIMED IS:

1. A method for generating ultrabright multikilovolt coherent tunable radiation in the x-ray region of the electromagnetic spectrum, comprising:
   (a) generating pulsed laser radiation having a chosen power, pulsewidth and wavelength;
   (b) generating atomic clusters having a chosen size and density;
   (c) directing the laser radiation into the atomic clusters wherein atomic excitation is produced with selected inner-shell electron atomic electrons being removed from the atoms without the removal of all of the electrons in the next outermost shell, thereby generating a hollow atom array having a population inversion from which a chosen wavelength of radiation is emitted and amplified, and wherein a self-trapped plasma channel region having a nonlinear mode of confined propagation for the chosen wavelength of amplified radiation is formed; and
   (d) controlling the density of said atomic clusters, the density of plasma electrons, and the pulsewidth, wavelength and power of the laser radiation such that the chosen wavelength of amplified radiation is tunable over the wavelengths for the hollow atom array .
2. The method as described in claim 1, wherein the cluster size is chosen to minimize the laser intensity required to excite substantially all of the atoms in the cluster.
3. The method as described in claim 1, wherein the pulsewidth is chosen such that atomic excitation occurs on a timescale which is short compared with recombination processes in the plasma produced.
4. The method as described in claim 3, wherein the pulsewidth is less than 1 ps.
5. The method as described in claim 1, wherein the atoms in the clusters are selected such that the chosen wavelength is emitted and amplified.
6. The method as described in claim 5, wherein the atoms in the atomic clusters are heavy atoms.

7. The method as described in claim 6, wherein the atoms include Xe and the laser radiation includes 248 nm radiation.

8. An apparatus for generating ultrabright multikilovolt coherent tunable radiation in the x-ray region of the electromagnetic spectrum, comprising in combination:

   (a) a pulsed laser for generating radiation having a chosen power, pulsewidth and wavelength;

   (b) means for generating atomic clusters having a chosen size and density; and

   (c) means for directing the laser radiation into the atomic clusters wherein atomic excitation is produced with selected inner-shell electron atomic electrons being removed from the atoms without the removal of all of the electrons in the next outermost shell, thereby generating a hollow atom array having a population inversion from which a chosen wavelength of radiation is emitted and amplified, and wherein a self-trapped plasma channel region having a nonlinear mode of confined propagation for the chosen wavelength of amplified radiation is formed; and

   (d) means for controlling the density of said atomic clusters, the density of plasma electrons, and the pulsewidth, wavelength and power of the laser radiation such that the chosen wavelength of amplified radiation is tunable over the wavelengths for the hollow atom array.

9. The apparatus as described in claim 8, wherein the cluster size is chosen to minimize the laser intensity required to excite substantially all of the atoms in the cluster.

10. The apparatus as described in claim 8, wherein the pulsewidth of the laser is chosen such that atomic excitation occurs on a timescale which is short compared with recombination processes in the plasma produced.

11. The apparatus as described in claim 10, wherein the pulse width is less than 1 ps.
12. The apparatus as described in claim 8, wherein the atoms in the clusters are chosen such that the chosen wavelength is emitted and amplified.
13. The apparatus as described in claim 8, wherein the atoms in the clusters are heavy atoms.
14. The apparatus as described in claim 13, wherein the atoms include Xe and the laser radiation includes 248 nm radiation.